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# 1- Popular frameworks research (summer week 1)

**Document 1:** **NN most popular libraries.docx** (<https://drive.google.com/open?id=1XH2S-7eN1wl2EYqiN9XQjaOBKwkfuyGq> )

The first step of the study consists of gathering neural network most popular frameworks. After some research on the internet, most results suggested these frameworks:

1) TensorFlow

2) Keras

3) PyTorch

4) Caffe

5) Theano

6) MXNET

7) CNTK

8) DeepLearning4J

9) Caffe2

10) Chainer

11) FastAI

And others

Reference : <https://towardsdatascience.com/deep-learning-framework-power-scores-2018-23607ddf297a>

I referenced other websites in the google document. I also noted each framework’s Github, bug repository and website.

# 2- Mining scripts for issues and comments (summer week 1 and 2)

**Document 2:** **ml-framework-bugs\script\_issues.py**

From a csv containing frameworks’ information, mines each framework issues (with label or not) and saves them in a json and a csv file.

**Document 3: ml-framework-bugs\script\_comments.py**

From the issues’ csv, mines all comments of all issues in the csv and saves them in a json and a csv file. The labeled issues’ comments will be already in their own csv, since labeled issues are already separated after using script\_issues.py.

# 3- Issues manual reading and Keywords search reading (summer weeks 2-6)

*I apologize for the formatting of the tables. Be mindful of the table name, as some “relevant bugs” tables are long.*

**Google Drive folder :** [**https://drive.google.com/open?id=1nSMmAo0kiAlpdIVdbZFeolyICWfQNycH**](https://drive.google.com/open?id=1nSMmAo0kiAlpdIVdbZFeolyICWfQNycH)

**Document 4: Manually reading all frameworks** (<https://drive.google.com/open?id=15KPcTNVlmCPgZum-dQTl-JN7oG2lMZkQ_uss6LdeA7s> )

* TensorFlow (page 1):
* Relevant: manual reading of recent relevant issues. Brief look at the repo to find keywords/aspects some for the classification of bugs.
* Non-relevant: manual reading of recent non-relevant issues. Brief look at the repo to find some keywords/aspects for the classification of bugs.
* Caffe (page 2):
* Relevant:
  + Legitimate issues: manual reading of recent relevant issues. Brief look at the repo to find some keywords/aspects for the classification of bugs.
  + [label:bug] Exhaustive manual reading of Caffe issues with label:bug. The “Our Notes” columns contains Emilio’s opinion of the impact of bugs, which is a better indicator than the grade in the “Issue title” column. From #3254, “Our Notes” columns’ is an estimation of the bug impact. #297 and #284 are attempts to classify issues in the Deep learning stages.
* Non-relevant (page 8): One example of crashing bug. Three possible examples of PR probably having a minor impact on models.
* PR: is not a list of PRs, but a list of keywords.
* Sonnet (page 10):
* Relevant: exhaustive reading of all closed issues. Emilio’s notes in “Our Notes” column.
* Non-relevant: one non-relevant issue that was confusing. No Emilio notes.
* PR: No Emilio notes. I started looking at Sonnet’s PRs, but I did not continue.
* Swift for TensorFlow (page 12):
* Relevant: exhaustive reading of all closed issues. No Emilio notes.
* Non-relevant: non-relevant issues that were confusing. No Emilio notes.
* PR: empty.

**Document 5: manually reading Keras** (<https://drive.google.com/open?id=1ZJHPlkg1C0d9IOj3f6SpoegnSaG1TbGzQBfDgl19umQ> )

* Keras relevant issues (page 1):
* Relevant: manual reading of recent closed relevant issues. Covers a fewer number of issues than PyTorch. I started to focus on Pytorch because of its clearer version’s documentation. No Emilio notes.

**Document 6: Manually reading PyTorch (S2019 version)** (<https://drive.google.com/open?id=1m-pJxy1R00Gm4Vvi2lHc6bksKjqL8fmdVxOiaKfG-qo> )

* This document contains commit numbers for almost all issues/commits noted. The version number is also noted for those that was easier to retrace.
* PyTorch relevant issues (page 1):
* Relevant: manual reading of recent closed relevant issues. Covers a good number of issues, but probably not all, because I also used keywords. Most of the issues come from code>releases tabs on GitHub. No Emilio notes.
* PyTorch keywords issues (page 4):
* Relevant: manual reading of numerous issues found using grep and gitlog with keyword “bug” (and possibly “fix” and “bugfix” too…). I read a certain number of issues, then skipped a number of issues to “randomize” the reading. No Emilio notes.
* PyTorch files history, suggestion from the 9th of July meeting (page 10):
* Relevant: exhaustive reading of changes history for conv.py, batchnorm.py, maxpooling.py, pixelshuffle.py and pooling.py. No interesting results for maxpooling and pooling. No Emilio notes, but he said #12952’s previous commit causes a crash.

# 4- Frameworks installation documentation (summer weeks 4 and 5)

**Google drive folder :** [**https://drive.google.com/open?id=1lOnB1Av7gzzz6vXt\_XXx6iiXVIRLYiZq**](https://drive.google.com/open?id=1lOnB1Av7gzzz6vXt_XXx6iiXVIRLYiZq)

**Document 7:** **releases version support TensorFlow** (<https://docs.google.com/document/d/19T5njgSxdc74wnznbd3BssWKeVLZNSwq2WlBhU26PQc/edit>)

1) TensorFlow versions’ compatibility (gpu) (page 1): dependencies’ version for each TensorFlow gpu version. The table describes which dependencies are needed to install a buggy version.

2) whl packages for each Python version compatible with TensorFlow 1.13 (page 2): whl packages are easier for the installation of the buggy version. I think this table is for TF 1.14, not 1.13 …

3) whl packages for each Python version compatible with TensorFlow 1.14 (page 3): whl packages are easier for the installation of the buggy version.

4) whl packages for each Python version compatible with TensorFlow 1.12 (page 6): whl packages are easier for the installation of the buggy version.

5) whl packages for each Python version compatible with TensorFlow 1.11 (page 8): whl packages are easier for the installation of the buggy version.

6) whl packages for each Python version compatible with TensorFlow 1.10 (page 11): whl packages are easier for the installation of the buggy version.

7) whl packages for each Python version compatible with TensorFlow 1.9 (page 13): whl packages are easier for the installation of the buggy version.

8) whl packages for each Python version compatible with TensorFlow 1.8 (page 15): whl packages are easier for the installation of the buggy version.

The tables for version 1.7 and earlier are not present because the study focuses on bugs corrected from year 2016 and after.

**Document 8: releases version support PyTorch, Caffe and Theano (**<https://docs.google.com/document/d/13JBxRsZd4wkD4ep2BjeJ_Cz8v081srwaAgvoNFsGWvs/edit>**)**

1) PyTorch versions’ compatibility (page 1): dependencies’ version for each PyTorch version. The table describes which dependencies are needed to install a buggy version.

2) whl packages for each Python version compatible with various PyTorch versions (page 2): whl packages are more convenient for the installation of the buggy version. NOTE: The links are for CUDA 7.5

3) Caffe versions’ compatibility (page 4): dependencies’ version for each PyTorch version. The describes which dependencies are needed to install a buggy version.

4) whl packages for each Python version compatible with various Caffe versions (page 4): whl packages are more convenient for the installation of the buggy version.

5) Theano versions’ compatibility (page 5): dependencies’ version for each PyTorch version. The table describes which dependencies are needed to install a buggy version.

6) whl packages for each Python version compatible with various Theano versions (page 5): whl packages are more convenient for the installation of the buggy version.

**Document 9: meeting notes (**[**https://drive.google.com/open?id=1QKWxlSCWA1x8Q611SBamsuXsP\_\_ZtayrkmOCj6AE\_eE**](https://drive.google.com/open?id=1QKWxlSCWA1x8Q611SBamsuXsP__ZtayrkmOCj6AE_eE) **)**

Produced by Emilio. Summarizes all subjects for 17th June 2019, 24th June 2019, 1st July 2019 and 16th July 2019 meetings. A diagram at page 4 describes the workflow used for the research process of the study

# 5- Call frequency of a bugfix (from summer week 7)

## 5.1- Existing tracers (week 7)

Python seems to have existing tools for tracing. C language doesn’t seem too.

<https://docs.python.org/2/library/trace.html>

<https://docs.python.org/2/library/traceback.html>

<https://pymotw.com/2/trace/>

## 5.2- C++ tracer code (summer week 7-8)

Files are in **ml-framework-bugs\C Tracer.**

The integration of this code may cause compilation problems related to links edition. Emilio has done work regarding this.

## 5.3- C++ syntax analyzers (summer week 7-10)

CastXML: <https://github.com/CastXML/CastXML>

<https://github.com/thewtex/CastXMLSuperbuild>

GCC-XML: <https://github.com/gccxml/gccxml>

CastXML Is the maintained version of GCC-XML. Using the Superbuild is much simpler. If you wish to build from source, you will need to install Clang and LLVM … You might want to read these guides to build them:

<http://clang.llvm.org/get_started.html>

<https://www.llvm.org/docs/CMake.html>

## 5.4- Python inserter of the trace call (summer weeks 8-12)

**Document 10: ml-framework-bugs\2019-07-22 code insterter\python\_insert.py**

The code in python\_auto\_insert shall be integrated in this script. In other words, this inserter should be an automatic inserter.

Command prompt call: python python\_inserter.py (commit\_sha)

Example: python python\_inserter.py efc3d6b65

**Document 11: ml-framework-bugs\2019-07-22 code insterter\python\_auto\_insert.py**

**is\_unindented\_insertable() and analyze\_python\_file() methods requires more testing.** It is not confirmed that they can cover all cases of insertion. The file ml-framework-bugs\2019-07-22 code insterter\test\_dataloader.pypresents many cases of indentation that would be useful in testing.

# 6- PyTorch issues reorganization (fall week 1)

Document 12: manually reading PyTorch (<https://drive.google.com/open?id=1m-pJxy1R00Gm4Vvi2lHc6bksKjqL8fmdVxOiaKfG-qo>)

This document contains more issues notes and analysis for PyTorch releases 1.2, 1.1 and keywords search commits.

Table 12.1: Bugs to classify. Contains all bugs of the current *analysis*. Each commit is colored after the predicted effect of the bug

Red: No effect is expected to appear or had not appeared after running the issue.

Yellow: More analysis is needed, the appearance of an effect is unsure

Green: Great chances of having an effect from running the bug

Table 12.2: To analyze. Contains bugs that have great chances of having an effect. Green-labeled bugs from the table 12.1 should be copied into this table. These bugs will be executed in before the table 12.1’s bugs.

Table 12.3: Experiment logs. Contains bug’s version building information and runs information. Each entry from table 12.2 should be integrated into this table. Important instruction: choose an unique “Experiment Name” and mark down your name and build date for each bug. ***Look at run metrics for practical results of the runs.***

# PyTorch building and training (fall week 2-8)

PyTorch builder: git repository ml-framework-bugs/auto-launcher (<https://github.com/EmilioRivera/ml-framework-bugs/blob/master/auto-launcher/README.md>)

More specifically <https://github.com/EmilioRivera/ml-framework-bugs/blob/master/auto-launcher/README.md#launching-a-container-for-building> for the command to launch the PyTorch docker builder. Step by step instructions can be found in /home/kacham/Documents/pyt\_build\_steps.txt. The instructions tell in order which commands should be executed after launching the docker builder. The docker builder produces a whl (executable PyTorch package) for the commit checked out.

## PyTorch training with trace calls (fall week 8)

Trace calls were added to changed lines of code to demark the code parts that were called. To know if a bug is called, trace calls were added to the changed code. These trace calls write a output message in tracelogs when reached. At this point, I updated /home/kacham/Documents/pyt\_build\_steps.txt to follow the added steps for trace inserting. Basically, after launching the build docker, you need to checkout the commit of the bug, insert trace calls and build PyTorch. The resulting whl will be composed of the inserted PyTorch code.

Example:

Mini tracer: The trace call template and examples are in /home/kacham/Documents/ml-framework-bugs/C\_Tracer/mini\_tracer/main.py for Python and Documents\ml-framework-bugs\C\_Tracer\mini\_tracer\main.cpp for C++. Documents\ml-framework-bugs\C\_Tracer\mini\_tracer\results contains text outputs of the trace call in the main.py and main.cpp files. It can be deleted.

EXAMPLE:

PyTorch training: git repository ml-frameworks-evaluation (<https://github.com/EmilioRivera/ml-frameworks-evaluation/blob/master/README.md>) contains instruction for training of models with PyTorch. For training, step by step instructions can be found in /home/kacham/Documents/pyt\_build\_steps.txt.

The client can be launched by running /home/kacham/Documents/ml-frameworks-evaluation/training\_run.sh directly. training\_run.sh makes one training container for each .env file in the BASE\_DIR path. The env files can be found at /home/kacham/Documents/ml-frameworks-evaluation/envs. Each contains settings for training and for output files names. The most important settings for output files names are BUG\_NAME, CLIENT\_MANUAL\_DEPENDENCY and EVALUATION\_TYPE. CLIENT\_MANUAL\_DEPENDENCY is the commit SHA and it is used to launch the whl of the commit built.

The server is an executable docker image. Launching a docker container will automatically start the server. The training result will be written in the “results” docker volume.

A backup of training metrics is saved at /home/kacham/Documents/2019-10-24\_trainings\_backup. Those results were created from 2 runs training on EvaluationNet, EvaluationVGG and EvaluationAlex. There might be another backup in the “share” shared repository.

# Add more models to training (fall week 3)

Adapt python models in the code. From the source code at <https://pytorch.org/docs/stable/torchvision/models.html>, implement new models in /home/kacham/Documents/ml-frameworks-evaluation/src/client/models/pytorch\_models.py. EvaluationVGG and \_VGGG were implemented from PyTorch vision source code and EvaluationModel base class. It is recommended to follow the overall implementation of EvaluationVGG and \_VGGG for the other models.

# Parameters checker (fall week 3-5 for params checker)

Params\_checker: A little script to confirm the consistency of model initialization (/home/kacham/Documents/ml-frameworks-evaluation/src/client/params\_checker.py and /home/kacham/Documents/ml-frameworks-evaluation/src/client/params\_checker\_test.py for unit tests)

# Mini tracer and python debug tool (fall week 6)

Mini tracer: See “Mini tracer” in week 2-8 section.

Debug tool: Breakpoints were used to help finding the code parts that are called. Python source debugger was pdb (<https://docs.python.org/3/library/pdb.html>). C debugger was composed of sigint signals (<https://stackoverflow.com/a/4326474/9876427>), but this doesn’t work well, the program is interrupted and cannot retake after the interrupt.

# (fall week 9)

Sklearn framework work pipeline for training: The first few sections contain links for study and analysis. Releases links indicates important changes between versions and might reveal functional bugs. The source code noted links directs to some of the most used machine learning models. KEYWORD SEARCH/HISTORY SEARCH. BUGS but the label hadn’t been really showing functional bugs.

CLEAN THE BUGS TO CLASSIFY TABLE

After the first sections are the tables whose are similarly structured to manually reading PyTorch <https://drive.google.com/open?id=1Sx_4l9dTnvF_YYJwbDe_KNH-J4aWDjpR_qJykWikzX8> . The “To analyze” is less used. Because of cherrypicking bugs, they were directly put into the “Experiments log”.

The building instructions are located at these two websites. Cython is needed to recompile the source code. Make sure that Cython is in the environment path. With Cython installed, only two instructions should be necessary to recompile the source.

Training de bogues PyTorch (14h), plusieurs erreurs de cpu/cuda. Pas d’effet significatif du bug sur le training.

Recherche de bugs intéressants, compilation et modification de bug sklearn (7h)

Script de training utilisant sklearn, recherche de dataset et organisation du flot de travail sklearn (14h)

# Falll week 10

Résoudre un problème de format des données (7h)

Exécuter des versions de sklearn avec le script de training de sklearn. Le modèle entraîné est de type Bayésien (7h)

Rechercher d’autres bugs susceptibles d’avoir des effets sur l’entraînement de modèles Bayésiens (7h) et les exécuter (14h)

# Fall week 11

Exécuter des versions de sklearn avec le script de training de sklearn. Le modèle entraîné est de type Bayésien et de type régression linéaire (14h)

Rechercher des bogues susceptibles d’avoir des effets sur l’entraînement de modèles K-means (7h). Aucun bogue ne semble intéressant.

Rechercher des bogues susceptibles d’avoir des effets sur l’entraînement de modèles de type arbre (14h)

# Fall week 12

Rechercher des bogues susceptibles d’avoir des effets sur l’entraînement de modèles basés sur le arbres (7h)

Documentation des bogues de sklearn qui n’ont pas d’effet sur les

Automatisation de l’insertion des appels des traceurs

All lines\_numbers/indexes are the real number -1.

Each <<[MAIN] balisa>> indicates the main callable function of each module

Inserter :

All lists keeps the same dimensions and size in order of code simplicity. For example, lines numbers first dimension length will be the same value as changed files in the commit, and the array spanned by lines\_numbers will keep that dimension, even though some lines will be not insertable in to\_be\_inserted\_lines\_numbers. In the case of non-insertable lines, the line value will be None to indicate that it is not insertable.

Class diagram: